

AMATEUR SATELLITE REPORT

AMSAT's Newsletter for the Amateur Space Program.



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FCC Readies "OK" On U.S. Mode L Operations

News from two sources indicated the long-awaited break in the U.S. Mode L logjam was at hand. At presstime FCC Special Services Division Chief, Ray Kowalski, told ASR an announcement was to be made on Tuesday, June 18.

In a related discussion, ARRL Counsel Chris Imlay, N3AKD, told ASR a temporary authorization for Extra Class licensee-only access was already out. He noted document DC-119 as the authority.

WARC-79 authorized use of 1260-1270 MHz earth-to-space but due to an administrative oversight, the enabling authority was never enacted. AMSAT and ARRL have been working to clear general Mode L use on AO-10 since the oversight was discovered in Autumn 1984. Although U.S. access to Mode L was never absolutely denied, neither was there clear authority for use. All parties attending the matter agreed the oversight would be cleared by appropriate administrative action. Nevertheless, absence of clear authority threw a wet blanket on Mode L growth until now. With the issue now out of question, Mode L growth is expected to increase. Phase IIIC will have a Mode JL transponder aboard and growth in users of AO-10 is seen as preceding a general migration to Mode L over the life of the two satellites. Indeed, according to Engineering VP, Jan King, W3GEY, Mode L will become increasingly popular by decade's end. Already the follow-on Mode S is making its debut on Phase IIIC.

ARRL Foundation Matching Fund Donors Rewarded With Special Pins

AMSAT HQ announces that for a limited time only, special, distinctive pins will be awarded to donors of \$20 or more to the ARRL Foundation Phase IIIC fund. The pins are gold plated and measure approximately 3/4" by 1 3/8". They are an absolutely unique way of saying you care enough to send Phase IIIC into orbit (by supporting the matching fund!). Each \$20 donated to the matching fund yields \$40 towards Phase IIIC. Send to AMSAT, C/O ARRL Foundation Matching Fund, P.O. Box 27, Washington, D.C. 20044.

Arturo Carou, LU1AHC, of Buenos Aires recently got the

ARRL Foundation matching fund drive off to a rousing start with a very generous \$1000 donation! *Muchos gracias mi amigo!*

When sending in your check for \$20 or more, please indicate you wish to receive the special pin. They are available in very limited numbers on a first come, first served basis. When they are gone, that's all. Don't be disappointed. Send today and help Phase IIIC with its four fabulous transponders make it to orbit next year on time.

Teleconference Net Airs To Rave Reviews

In what observers are calling the "best of the lot", seven AMSAT leaders teamed on Friday evening, June 14, to fill the airwaves over North America with AMSAT's story. Two hundred and fifty repeaters were linked in the North American Teleconference Radio Net for over two hours. AMSAT panelists W6SP, K8OCL, NK6K, W3IWI, W3GEY and W3XO addressed various aspects of the Radio Amateur Space Program. Panel moderator WA2LQQ organized the panel of experts as they detailed their areas of specialty and then fielded questions from the listening audience.

Estimates of listenership ranged upwards from 10,000. Coverage extended across the U.S. and Canada. The Midway Amateur Radio Club again sponsored the NTRN. The Darome Connection of Minneapolis supplied the technical control facilities.

Real-time transmission on AO-10 was not possible because the satellite was not in view at the time.

Lead-off panelist W6SP gave an overview of what there is to do on satellites today. K8OCL then discussed the basics and how to get started especially on a budget. Next, NK6K enticed many with news of up-coming packet radio satellite activity including PACSAT, JAS-1 and the RUDAK experiment on Phase IIIC (See article in this issue.). Then W3IWI gave a splendid description of why objects stay in orbit and why some orbits are better than others for communication. W3GEY told of future projects including Phase IIIC and Phase IV. He mentioned the need for more user feedback on the types of communications facilities that should be provided in the future. W3XO discussed the Space Shuttle 51F mission now scheduled for 12 July 85. He described the types of equipment and communications

that could be expected. Finally, W6SP spoke on some of the several awards that may be garnered using today's satellites.

A special feature of the NTRN was a pre-recorded interview with candidate "Teachernaut" Jeannine Duane, WB2MBW. Jeannine is an AMSAT Member and teacher who would like to become the first citizen in space (See ASR 102).

Many who listened said it was the fastest 2 hour program they could remember.

Meanwhile, sources of audio recordings of the event were being solicited. The primary recording facility in California had difficulty with the result that the recording is only marginally usable. AMSAT needs a good-to-excellent grade tape recording to dub for distribution to those who were unable to hear the net in real-time. Please contact WA2LQQ at P.O. Box 177, Warwick, N.Y. 10990, if you can help in this connection. AMSAT plans to offer copies of the tape at nominal cost for club presentations and similar education/indoctrination purposes.

The next NTRN will be on Friday, 13 Sept. 85 and will feature Paul Rinaldo, W4RI, Editor of QST and Publications Manager at ARRL. Paul will speak on ACSSB. Paul is one of the founders of Project Companion, a joint project of Project OSCAR, AMSAT and ARRL. WB6JNN of Project OSCAR and WA2LQQ of AMSAT are the team leaders in their respective organizations. Project Companion has the primary objective of introducing and proliferating ACSSB techniques in the Amateur Radio and Amateur Satellite services.

South American Pair Tops ZRO-Runs With Z7's!

With two ZRO-Memorial Technical Achievement Award test runs now complete, a pair of South American stations lead the way with top rated scores of Z7 or 21 dB below the beacon. Several dozen others have scored Z6, 18 dB down.

The leaders so far are Mike Harris, VP8NO, Falkland Islands and Rubens Murillo Marques, PY2MSG, Sao Paulo, Brazil. Both earned their outstanding Z7 rating on the 24 May 85 ZRO-Test run. No one has yet attained the fabled Z8 rating. Theory predicts the Mode B transponder noise floor should be about 21 dB below the beacon. Given the amplitude error at the source of 1 dB or less, both Z7 stations were probably copying the test signal with less than a 1 dB signal-to-noise ratio. Several very-well equipped 2 meter EME stations including K1WHS and K6MYC will be stalking the Z8 phantom when the next test occurs at 0815 UTC, 30 June 85.

Further runs after the 30 June event will have to await autumn when the eclipse season has past and the sun-angle has moderated. Poor sun-angle requires re-orientation of the satellite which in turn provides pointing angle advantages to some and disadvantages to others. Thus the next test after the 30 June edition will likely occur in late September or early October.

Certificates and endorsements were on-schedule and due to be mailed out the first week of July.

The complete list of qualifiers as of 18 June 85 was as follows:

Z7: VP8NO, PY2MSG

Z6: WA5NOM, W3KH, WA5PCN, K2GLS, W9YCV, W6MSG, WD0EQP, N6KDY, W3OEJ, WA1MBA, WD4FAB, WB4OSS, VE5XU, W8GUS, N9HR, N2BKT, W5IU, K9NO, K9OPO, W8GQW, KA9NAH, WA3WBU, LU8EBH.

Z5: KY7J, KS8Z, N5EEG, WD4AHZ, K8RSP, K0BEJ, WA1AYT, KG6LC, WA5ZIB.

Z4: N1CHM, VE7EFF.

Z3: W6HDO.

VP8NO was using a single crossed yagi with 6 elements in each plane phased for RHCP. His pre-amp was a BF981 device mast-mounted with gain set by output attenuator to 8 dB. His receiver was a Microwave Modules MMC 144/28 feeding a Racal RA217 with 200 Hz filter. A very nominal arrangement indeed. Some see Mike's quiet QTH as his major ace-in-the-hole.

On the other hand, PY2MSG believes in lots of aluminum in the air. His array of 4 homebrew 16 element boomers fed a GaAsFET pre-amp (device unspecified) and a TS-700A receiver. Rubens (PY2MSG) signed his entry as Rubens Murillo Marques, PhD. Do you suppose he "doctored" his pre-amp a bit? Like in liquid N2?

Austere AO-10 Sked Reflects Eclipse Risks

AO-10 spacecraft controllers have determined an operating schedule for the critical eclipse period which begins in August. The schedule will be as follows according to VE1SAT.

Off	030 - 189
L	190 - 206
B	207 - 029

The new schedule goes into effect 1 Aug. 85 and will remain in effect for a planned 4 weeks ending on/about 1 Sept. 85. The current schedule will remain in effect until 1 Aug.

Several key attitude adjustments will be necessary to assure spacecraft survival during this very critical period. Beginning 3 June 85 the Bahn longitude will be adjusted in a series of maneuvers. By 3 June the Bahn longitude will be set at 190 degrees. During the first week of July, the longitude will be further increased incrementally until by 1 Aug. the s/c will be at 230 degrees and 15 degrees of latitude (either + or - TBD). In a fast flip over, the longitude will be returned to the 140 to 150 range by 1 Sept. 85.

VE1SAT indicated the worst case eclipse will occupy the window MA 70 - 130. The intervals 30 - 70 and 130 - 189 are recharge periods. According to analysis by KA9Q as well as VE1SAT and others, there are severe thermal constraints during August as well as the obvious electrical budget constraints imposed by the eclipses. Part of the reason for the extensive maneuvering is to reduce the very real threat of freezing the batteries during a long eclipse.

While the dynamics are well-understood and the risk is under control, all involved including VP-Eng. W3GEY indicate the upcoming episode poses the most serious threat to AO-10 experienced so far and perhaps during its design life. AO-10 was 2 years old 16 June 85.

Stop Press: FCC authorizes Mode L for Techs and up; deletes Extra Class only constraint.

Satellite Bulletin Schedule

Day	Date	Time	Orbit#	MA	SSP
Sat 22	Jun 85	1245	1523	85	147W, 1.15
Sat 29	Jun 85	0900	1537	108	87W, 6.65
Sat 06	Jul 85	0600	1551	147	32W, 14.35

Short Bursts

- AMSAT Life Member Don Wallace, W6AM, has died of a stroke at the age of 86. One of the world's most famous hams, Don had played host to a group of AMSAT visitors late last year. (See ASR 94/95). The end came on 25 May in a Long Beach hospital. He suffered a stroke while playing cards at a club the day before. He had been the world's top DXer for 30 years with 366 countries confirmed. His famous rhombic farm had seen thousands of awed hams attend his regularly scheduled open house occasions. He will be missed.

- According to 4X4GI, the leader of the AMSAT Israel organization, 4X6MF, Steve, has died. Details to follow.

- As noted in ASR 103, contacts on AO-10 as well as other OSCARs will now count towards the Satellite DXCC award. The Satellite DXCC Certificate is a one-time only award. Applicants must submit ARRL forms CD 164 and CD 253 for credit. These forms are available from ARRL HQ for a business sized SASE with 39 cents postage affixed.

- New Area Coordinator appointments have been announced by Chief Area Coordinator WA6VGS. The new appointees are: Dick Beers, WD9IIC, replacing W9JUV who, at his request, becomes assistant to WD9IIC. Howard Ziser, WA3GOV, has been appointed Area Coordinator for Eastern Pennsylvania. Dave Lewis, KL7ETZ, has been appointed Assistant Area Coordinator for Southeast Alaska. Keith Pugh, W5IU, and Rusty Reeve, KT5U, have been appointed Assistant Area Coordinators for North Texas. Congratulations to the new appointees!

- HC1BI plans a DXpedition to Galapagos, HC8, 19 to 24 Aug. AO-10 operations are definitely a part of Bene's plans.

- Watch for ZK1XE from 30 July to 3 Aug. on 145.900 SSB.

- AO-10 will be in a special schedule to support a demonstration by UA3CR on 29 June 85. The demo station will be signing R2P. Watch for them after perigee on 29 June between 1600 and 1700 UTC. Contacts are cordially invited by UA3CR.

- A related EME event will be run from R2P on 29 June from 1700 to 1800 UTC. Calling frequencies will be 144.010 to 144.012 MHz and 432.010 to 432.012 MHz.

- AMSAT HQ reminds members that nominations for Director are due not later than 31 July 85.

- Also, papers for the AMSAT Technical Journal are due not later than 1 Aug. 85.

- VK0AQ will be operating AO-10 from Antarctica until November.

- W3GEY and WA2LQQ addressed a group of foreign students of the U.S. Technical Training Institute at ARRL HQ

on 6 June 85. The invitation to talk on the Amateur Satellite Service came from Dick Baldwin, W1RU, ARRL International Affairs Vice President.

RS-8 Failure Imminent

RS-8 is showing end-of-life signs according to veteran satellite operators. Spacecraft controllers in the USSR have said the satellite is not responding to commands well while operators have noticed various malfunction symptoms. These symptoms include intermittent passband operation and possibly anomalous telemetry. RS8 was launched in salvo fashion with RS-3, 4, 5, 6 and 7 on 17 Dec. 81. Only RS-5 and 7 are in full working order now. RS-6 succumbed earlier this Spring while all others in the salvo have ceased operation. Occasional reports suggest RS-1 may be sending anomalous telemetry. RS-1, launched 26 Oct. 78, apparently ceased functioning reliably (predictably) in May 1980.

According to G3IOR, Russian controllers began seeing serious RS-8 malfunction symptoms on or about 4 June 85. W0CA reported similar observations on 9 June 85.

The failure of RS-8 would leave RS-5 and 7 as well as AO-10 and UO-9 and 11 as the remaining operating OSCARs.

Shuttle Launch Scheduled For 12 July

The 12 July 85 launch of Tony England, W0ORE, aboard Space Shuttle Challenger at 2030 UTC 12 July 85 will mark the second Ham-In-Space mission. Tony will fly mission 51F in a 232 nautical mile orbit inclined 50 degrees. The higher inclination gives listeners in the northern states and provinces a shot at hearing the astronaut directly on his downlink of 145.55 MHz.

The Shuttle will land at Edwards AFB, California after a scheduled seven day flight.

Voice and SSTV modes are planned both using FM on 145.55. The earlier-planned 10 meter transmissions had to be scrubbed because of antenna restrictions.

Meanwhile, it was learned that President Reagan may attempt to communicate with W0ORE via 2 meters in conjunction with the Young Astronauts Program (YAP), a Private Sector Initiative of the White House. AMSAT and ARRL officials recently met with YAP to discuss in preliminary, general terms how Amateur Radio and the Amateur Space Program could work in tandem to challenge today's youth.

The Goddard Amateur Radio Club again plans to retransmit Shuttle audio on the amateur bands. Frequencies cited were as follows:

3860 kHz SSB (evenings/night)

7185 kHz SSB (days)

14295 kHz SSB (continuous)

21390 kHz SSB (conditions permitting)

147.45 MHz FM (continuous)

The JPL Amateur Radio Club plans to operate on 224.040 and 145.460 MHz serving Los Angeles and Pasadena.

The Marshall Space Flight Center will transmit on 145.430 MHz serving greater Huntsville.

The NASA/Ames facility near San Francisco will offer Shuttle audio on 145.580 MHz.

(Tks, ARRL Letter)

AMSAT DL Specifies Mode L Packet System

The Phase 3C satellite may carry up to four transponders as mentioned previously in these pages (See ASR #98/99). A "standard" Mode B transponder will be joined by a novel Mode JL transponder. Besides the possible Mode S transponder too, a fourth transponder has also been proposed. The fourth transponder would be a Mode L packet transponder as proposed by AMSAT DL.

During the weekend of February 15 through 17, AMSAT DL hosted a formal meeting to define the packet payload for P3C. The experiment has been named RUDAK for "Regenerative Umsetzer für Digital Amateur-Kommunikation." Roughly translated, that's an Amateur Radio digipeater.

The following paper has been published by AMSAT DL to elaborate on the project. The paper has previously been published in the Fourth ARRL Amateur Radio Computer Networking Conference proceedings (30 Mar 85) and in AMSAT Journal, the official magazine of AMSAT DL, in its March/April 1985 issue, number 27/28. We are grateful to Herr Werner Haas, DJ5KQ, AMSAT DL Vice President, for the excellent translation from the German.

Attending were:
Hans Peter Kühlen DK1YQ Program Manager RUDAK project
Peter Guelzow DB2OS Project Manager RUDAK project
Heinz Moelleken DL3AH Ground Systems Manager RUDAK project
Werner Haas DJ5KQ Vice President AMSAT-DL e.V.
Karl Meinzer DJ4ZC President AMSAT-DL e.V.

A. General

After a brief review of the performance and capabilities of existing packet systems, the board set the objectives for the RUDAK payload as follows:

1. Compatibility of the system with the present AX.25 standard and the existing Packet Radio boards (e.g. TAPR).
2. Regular Amateur communication equipment should be used without the need of modification or intrusion.
3. Moderate to small antennas should be sufficient for low bit error rates.

Relating to point three, the board agreed on the nominal amateur station performance parameters as detailed in Annex A. With these in mind, the second point was analysed in great detail with particular reference to link-performance and modulation techniques available with these results:

a. Link budget considerations require efficient techniques for the downlink which today can only be achieved using (transparent) SSB-equipment with demodulation at baseband (audio). This limits the practical achievable data-rate to 1200 bits/s (RSM) or lower (BPSK); a performance better than 12 dB Eb/No can be expected.

b. The uplink could employ standard FM-equipment for straight FSK modulation. Experiments by DB2OS showed that 2400 bits/s (biphase) can be handled by standard equipment without problems. It remains to be investigated if 4800 bits/s (NRZ) also can be handled or if special measures are necessary to eliminate the influence of the DC-component (e.g. scrambling for spectrum shaping). Higher data rates cannot be achieved with standard radios. Technical papers reviewed indicate that with a discriminator type of demodulator 17 dB Eb/No are necessary for 2400 bits/s and about 25 dB for 4800 bits/s (FM-threshold). The

meeting concluded that also BPSK for the uplink is viable without intrusion into equipment by using a high-power passive BPSK modulator between transmitter and antenna or between exciter and PA. This approach imposes no restriction on the data rate and yields also a better than 12 dB Eb/No performance. The resulting spectrum needs to be investigated and bandwidth-limiting measures may turn out to be necessary. The board concluded that in view of the long visibility of the satellite no significant on board storage would be employed. The uplink using essentially ALOHA signalling should have about six times the capacity of the downlink. On board storage should be sufficient to buffer about ten times the packet differential between downlink and uplink (6-7 kByte).

c. Presently there is no suitable ISO-layer 3 network definition available. Thus the payload initially should emulate the existing digipeater function as defined in the AX.25 version 2.0/Oct. 84. If a more sophisticated level 3 protocol becomes available, the S/C will be updated accordingly.

B. Design decisions taken by the board

a. The board agreed on the following main features as design guidelines for the RUDAK experiment:

- Nominal amateur equipment as defined by Annex A required the selection of the following data-rates and modulation techniques:

Uplink: 2400 bit/s differential biphase PSK (± 90 deg)
(24 cm) spectrum shaping TBD
Downlink: 400 bit/s differential biphase PSK (± 90 deg)
(70 cm) spectrum shaping as used in AO-10

- Continuous operation of the beacon in Mode L (24/70 cm); independent from the transponder pass-band (and AGC)

— "Bulletin Board" i.e. cyclic repetition of information packets containing updated Satellite status (telemetry) orbit information (Kepler data) and present position (MA)

uplink parameter-set to be used by Packet Radio Stations wishing access to RUDAK (to eliminate unnecessary trial and error experimentation), etc.

— RUDAK programmes will be resident entirely in RAM facilitating software updates to be executed by AMSAT control stations via the regular P3-C command system.

— Packet first-in-first-out (FIFO) buffer (6-7 kByte) plus additional storage consistent with available memory to be used.

— Continuous self-test of the s/w with error correction in case of soft errors and auto-recovery in case of problems.

b. The original RUDAK design constraints (power 5 W, Volume 5 litres, mass 5 kg) were reviewed. It was concluded that one large P3 module (300 x 200 x 40 mm) would be sufficient to house the digital part of the experiment. The board was made aware that for a continuous operation of the RUDAK computer a considerably lower power consumption than 5 W would be desirable. If this turns out to be impractical, the availability of a stand-by mode with memory retention should be investigated. The transmitter and receiver of RUDAK will be built and integrated into the L-transponder by the group building the transponder.

c. A work assignment and schedule has been agreed upon consistent with the AMSAT P3-C launch.

d. The board elected H. Kühlen, DK1YQ, to compile the full RUDAK specification for definition of hardware and software requirements including the interfaces to the "Integrated Housekeeping Unit" (IHU) and the Mode-L-transponder.

e. Offers of participation to interested AMSAT groups

will be released after availability of the full specification set.

f. Development of a compatible ground MODEM and its early publication will be initiated in parallel with the space segment development.

Annex A. (Link assumptions and calculations)

Both Mode-B and Mode-L link-scenarios have been investigated. Mode-B finally was rejected because the expected downlink-performance in the 2m-Band was considered unsatisfactory in Japan and European metropolitan areas. Also the lack of suitable spectrum space in the 2m-band, the bulk and cost the required 2m-antenna and the fact, that the U-transponder exists already, entered into the decision. For the sake of completeness, the links are also presented for Mode-B.

Ground station assumptions:

Mode B: Receiving (2-m)	Gant: +9 dBi
	Tn: 1000 K
Transmitting (70cm)	Gant: +10 dBi
	P-Tx: 50 W -27dBW
Mode L: Receiving (70 cm)	Gant: +10 dBi
	Tn: 1000 K
Transmitting (24 cm)	Gant: +15 dBi
	P-Tx: 12 W -26 dBW

All links are to be designed with 7 dB margin to cover the less than perfect equipment to be expected in the amateur-environment.

Mode-B links: (for reference only)

Downlink	
P-Tx	5 dBW (3W)
Gant S/C	3 dBi (Min during spin)
link at apogee	-168 dB
misc. losses in link and S/C margin	-3 dB
Gant-ground	-7 dB
Received power ground Rx	+9 dBi
Pn (400 bit/s)	-161 dBW
---Eb/No	-173 dBW
	12 dB

Mode-B uplink (Assuming 2400 Bit/s FSK)	
Gant ground	10 dBi
P-Tx (50 W)	17 dE
link	-177 c
misc. Losses margin	-3 dB
Gant S/C	-7 dB
Received power at S/C	+9 dBi
Pn (500K, 2400 b/s)	-151 dBW
---Eb/No	-168 dBW
	+17 dB

Mode-L links (selected for RUDAK)

Downlink	
P-Tx-S/C (5W)	7 dBW
Gant-S/C	9 dBi
Link-loss (apogee)	-177 dB
misc. losses in S/C and link margin	-3 dB
Gant-ground	-7 dB
Power arriving at ground Rx	+10 dBi
Pn (400 b/s, 1000K)	-161 dBW
---Eb/No	-173 dBW
	+12 dB

Uplink	
P-Tx ground (12 W)	+11 dBW
Gant-ground	+15 dBi
link-loss	-187 dB
misc. losses margin	-3 dB
Gant-S/C	-7 dB
Power at S/C Rx	+13 dBi
PN (2400 b/s, 500K)	-158 dBW
---Eb/No	-168 dBW
	+10 dB (OK with PSK)

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